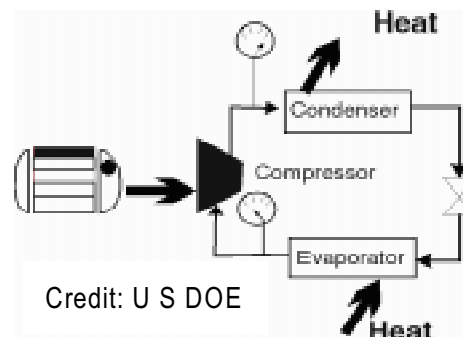


Applied Technology: Industrial Heat Pump

Concept

Industrial heat pumps are used to recover waste heat from one part of a process and boost its temperature so that it can be used in another part. The basic means to achieve this is mechanical compression. In a *closed cycle* heat pump, the working fluid circulates through heat exchangers, picks up waste heat in a low temperature evaporator, is compressed and elevated to a higher temperature in a mechanical compressor, and discharges heat to the process through a higher temperature condenser before being returned to the evaporator. In an *open cycle* heat pump, also called a *Mechanical Vapor Recompression (MVR)* heat pump, the process stream itself (e.g., low pressure discharge steam) is compressed to provide a higher temperature heat source to the process, eliminating the need for one or both heat exchangers.



Applications

- Heat recovery from wastewater, process, or refrigeration streams
- Facility heating, cooling, and dehumidification
- Multistage evaporation systems
- Distillation separation systems
- Lumber kiln drying

Technologies Replaced

- Direct fuel fired lumber kilns
- Steam heated evaporators
- Fossil fuel heating
- Steam heated reboilers for distillation
- Chemical dehumidification

Wastes Reduced

- Combustion products: CO_x, SO_x, NO_x, ROG, Particulates
- Process energy
- Solvents (distill for reuse)
- Hot wastewater stream thermal pollution
- Product loss in lumber drying

Potential in Manufacturing

<i>Indust</i>	<i>SIC</i>	<i>Pot</i>	<i>Indust</i>	<i>SIC</i>	<i>Pot</i>	<i>Indust</i>	<i>SIC</i>	<i>Pot</i>	<i>Indust</i>	<i>SIC</i>	<i>Pot</i>	<i>Indust</i>	<i>SIC</i>	<i>Pot</i>
Food	20	HI	Lumber	24	HI	Chem	28	MED	Stone	32	LOW	Elect	36	LOW
Tobac	21	LOW	Furn	25	LOW	Petrol	29	MED	Pmetal	33	LOW	Transp	37	LOW
Textile	22	MED	Paper	26	MED	Rubber	30	LOW	MetFab	34	LOW	Instr	38	LOW
Apparel	23	LOW	Printing	27	LOW	Leather	31	LOW	Mach	35	LOW	Misc	39	LOW

Credits: Dr. Philip Schmidt and Dr. F.T. Sparrow;
Unimar Group, Ltd; The Electrification Council; Electric Power Research Institute

Industrial Heat Pump

continued

Technology Advantages

- Reduces overall energy consumption
- Reduces distillation system pressures giving higher efficiency
- Faster, more uniform lumber drying
- Reduces combustion related emissions
- Boilers may be shut down for lower maintenance costs

Technology Disadvantages

- More sophisticated controls and technical support required
- High capital costs

Typical Costs

Capital Costs

\$20k - \$50k/MBTU
depending on size and
application

O & M Costs

Energy cost reductions of 60-
90% are not unusual

Potential Payback

1 - 3 years
depending on application

Installations

Case A - A conventional distillation column for separation of propane and propylene in a petrochemical plant was retrofitted with an MVR heat pump to recover the latent heat of the overhead vapor and recycle it into the reboiler. The heat pump ΔT or lift in this case was about 11 C°. The suction side of the 1,300 kW compressor reduced the pressure in the column, enabling distillation at low temperature. Once started, only the electrical energy of compression was required to operate the system, completely eliminating steam heating. Operating costs were reduced by over 70%, yielding a return on investment of 39% or payback less than 3 years for the installation.

Case B - Closed cycle dehumidification heat pumps are used in about 20% of existing lumber plants (approximately 1,000 units in place). These units are typically rated at 1-2 MBTU/hr of output and costs are \$100k - \$300k. Energy savings compared with conventional direct gas-fired kilns are on the order of 90%, yielding simple paybacks of 3-5 years on energy savings alone. Because the closed-cycle kilns operate at lower temperature and more uniform humidity conditions, product quality is higher and losses lower than in conventional kilns. It is claimed that many firms now prefer to buy lumber that has been dehumidification-kiln dried.



Major Vendors

Industrial Heat Pump

APV Crepaco (*heat exchangers*)

395 Fillmore Ave.
P.O. Box 366
Tonawanda, NY 14150
(716) 692-3000

Atlas Copco Comptec

(*compressors*)
Applications Department
46 School Road
Voorheesville, New York 12186
(518) 765-3344

Brown Fintube

(*heat exchangers*)
12602 FM 529
Houston, TX 77041
(713) 466-3535

Crispaire Corporation

(*industrial water heaters*)
E-Tech Division
3285 Saturn Court NW
Norcross, GA 30092
(770) 734-9696

E Back Systems, Inc

(*dehumidifiers*)
106 John Jefferson Road, Suite 102
Williamsburg, VA 23185
(800) 454-6012

Hitachi Zosen USA, Ltd.

150 East 52nd Street, 20th Floor
New York, NY 10022
(212) 355-5650

McQuay, Inc. (*HVAC*)

P.O.Box 1551
Minneapolis, MN 55440
(612) 553-5330

Nyle Corporation

(*wood drying*)
P.O. Box 1107
Bangor, ME 04402
(800) 777-6953

Tecogen (*chillers*)

P.O.Box 9046
Waltham, MA 02254
(617) 622-1400

This list of vendors of the indicated technology is not meant to be a complete or comprehensive listing. Mention of any product, process, service, or vendor in this publication is solely for educational purposes and should not be regarded as an endorsement by the authors or publishers.

Index to EPRI DOCUMENTS

Industrial Heat Pump

Industrial Heat Pumps, EPRI TechCommentary, Vol 1, No 4, 1988

Drying with Electric Heat Pumps, EPRI TechApplication, Vol 1, No 1, 1988

Pinch Technology, EPRI TechCommentary, Vol 1, No 3, 1988

*Most of the above references are copyrighted and are available from the
Electric Power Research Institute at a nominal cost.
Call 1-800-432-0267.*

This information is designed to help you determine **potential** applications for the technology. You are encouraged to contact one of the listed vendors or a consultant for details and pricing.

This manual is not intended as a recommendation of any particular technology, process, or method. Mention of trade names, vendors, or commercial products do not constitute endorsement or recommendation for use. It is offered for educational and informational purposes and is advisory only.

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